certain external causes or under exceptional physiological conditions; and, moreover, that in certain invertebrates the constant condition of the muscles corresponds rather to the modified than to the ordinary state of the muscles of the higher animals. If we proceeded to inquire in what this modification consists, Biedermann's answer would be that it may be distinguished in all cases by its electrical concomitants—all "modified" parts being relatively negative to similar parts which are unmodified. Thus when the adductor muscle of the nipper of the crayfish, which is normally in a state which resembles the "modified" state of an ordinary muscle, passes into a condition corresponding to that which is normally present in the muscles of the frog, a change takes place in the electrical relations of the structure of such a character that the sign of the electrical response to stimulation is reversed; it becomes negative instead of positive. Comparing these facts with others relating to vision, with the processes of secretion, and with other processes under the immediate control of the nervous system, one is encouraged in the hope that the relations between *ana* and *cata*, between rest and activity, between restoration and exhaustion, between integrity and hurt, will eventually be linked together by their electrical concomitants, and that by these characters it may be possible to ascertain with exactitude and certainty in how far these various antagonisms may be referred to a common principle.

Space will not allow us to give an account of the last chapter in Prof. Biedermann's book, which contains much that is new and important relating to the electromotive phenomena of secreting cells. Enough has been said to satisfy the physiological reader that the book is one which will have permanent value. It is, moreover, readable. The author tells us in his preface that he has done his best to get rid of "lehrbuchmässige Trockenheit." We think that he has fairly succeeded.

J. BURDON SANDERSON.

THE PHYSIOLOGY OF PLANTS.

A Popular Treatise on the Physiology of Plants, for the use of Gardeners, or for Students of Horticulture and of Agriculture. By Dr. Paul Sorauer, Director of the Experimental Station at the Royal Pomological Institute in Proskau (Silesia). Translated by F. E. Weiss, B.Sc., F.L.S., Professor of Botany at the Owens College, Manchester. (London: Longmans, 1895.)

OF all the sections into which the teacher of botany must divide his subject, perhaps the most difficult for him to deal with is that of vegetable physiology. No adequate elementary text-book has hitherto existed in English, the classical works of Sachs and Vines being, by their very completeness, too bulky and too full of detail for the student who is beginning the study of the subject. The work of Dr. Sorauer is intended to supply this deficiency. It is written especially for those whose interest in the matter is a practical one, and it deals, consequently, mainly with those questions which are of interest to the horticulturist as bearing on the problems of cultivation. Approaching the matter, however, from this side only, the book, as a work on physiology, to a certain extent comes short of what is needed, as many important sections of the subject are left untouched.

The author deals almost entirely with the problems of nutrition and their bearings on the details of horticultural practice. At the outset he strikes a rather heavy blow at what has hitherto been, unfortunately, the prominent idea of most agriculturists and horticulturists as to what constitutes the scientific side of agriculture. The latter has been held to embrace little or nothing beyond the chemistry of the soil, and everything not directly connected with this has been pushed into a secondary position, the metabolism of the plant and the chemical changes of its constituents being generally very superficially treated and held of not very great interest. It certainly seems strange that those who have been engaged especially in the cultivation of sensitive organisms under very varied and rapidly changing conditions should have given so little attention to the physiological peculiarities which these organisms present, and to their power of availing themselves of the various advantages that their environment offers to them. Dr. Sorauer, at the outset, strikes the right line when he points out that the chemistry of the soil, important as it is, plays only a secondary part in the development of the various plants which that soil supports, and directs his readers' thoughts chiefly to the problems of nutrition which the plant itself offers for consideration, showing that it is the business of the cultivator to endeavour to guide the natural development of the plant towards the special ends which are the needs of horticulture.

This idea, put prominently forward in the opening chapters, runs throughout the whole of the book. In developing it, the interactions between the soil and the plant, or between the plant and the atmosphere, are kept in the foreground, so that the gardener may realise that he is face to face with an actual struggle that is going on continuously between the organism and its environment, and that he is working to secure that in this contest those conditions of the latter may be secured which are most favourable to the success of the organism, and hence to its most complete development.

In the earlier chapters of the book, the author treats successively of the several members of the plant, the root, stem, leaf, flower, and fruit. Without going very deeply into their anatomical structure, he explains it sufficiently for the student to get an adequate comprehension of the duties or functions which are especially discharged by each. Again his mode of procedure is sound, as it is only function that gives the clue to the right interpretation of structure. The method, as carried out by Dr. Sorauer, is, however, open to a little objection, as it has led him rather to push too far the idea of the several members of the plant living for themselves, and to relegate a little to the background that of the plant being an organic whole, differentiated in different directions for the carrying out of different functions. Thus the leaf is spoken of as passing off into the vascular bundles of the axis only such materials as it cannot at once employ for its own growth, leading the student probably to the conception that the latter problem is for the leaf the primary one, and that the nutrition of the

© 1895 Nature Publishing Group

whole organism is only subsidiary when the relation of leaves to the rest of the plant is considered.

The chapters on the general processes of horticulture; the correlation of stems and roots, and their separate treatment; the principles of manuring; the theories of the proper supply of water to the plant, the aëration of its roots, &c., will be read with much attention, and will be found very useful in actual practice. The deposition of nutritive material in various parts of the plant, and the ways in which this can be influenced by different modes of treatment of the shoot at different ages, deserve careful study. The relation of such questions to the operations of pruning, grafting, &c., is discussed at some length, and the development of vegetative or fruiting branches respectively, is shown to be capable of great modification in the hands of the skilled horticulturist.

The book, however, though a valuable one for practical gardeners, leaves something to be desired as a contribution to the literature of vegetable physiology. Indeed some of the fundamental facts of the metabolism of the cell are, if not inaccurately, at any rate not clearly stated. The absorption of water is certainly one of the most important processes which it carries out. As described on p. 127, the early changes in the young cell connected with this process are stated as follows:—

> "Very soon there arise within the protoplasmic mass which fills up the cells, very small quantities of liquid substance (cell sap) which collect together to form small vesicles (vacuoles), and these give to the protoplasm a foam-like structure. Now, as the protoplasm becomes used up during the elongation of the cells, the vacuoles increase in number, run together, and force the remainder of the protoplasm outwards towards the cell wall."

Put in this way, the student would get the idea that the elongation of the cells takes place apart from the entry of water, and that the formation of the vacuole, that is, the increase of the cell-sap, is rather the result than the cause of the extension of the cell. No statement is made as to the cause of the entry of the water, the osmotic activity of the cell-contents, which really underlies all cell-growth.

Another strange statement is that the main cause of the growth in length of a young stem is the longitudinal tension in the pith, which "drags the young ring of wood with it, as long as the latter is still soft and thin-walled." This will be a new view to most physiologists.

Dealing with the absorption of nitrogen by certain leguminous plants, and the recently established fact that the atmosphere is a source of supply of this constituent, the author commits himself to the view that this absorption is carried out by means of their leaves.

In section 23, which treats of the substances formed by the leaves, we find several statements to which exception must be taken. The classification of the vegetable proteids is inaccurate, the latter being said to consist of albumins, caseins, and fibrins. Albumins are extremely rare in plants, and fibrin resembling animal fibrin is unknown. Globulins, which are numerous and varied, and albumoses, which have comparatively recently been investigated, are not even mentioned. The formation of starch grains in the leaves is thus described—

> "When the light shines on the leaf its transpiration is exactly increased, and its cells lose some of their water; then we may imagine the starchy substance to be forced out of the thickened (concentrated) cell-sap, and the latter will become more liquid."

The nutrition of the cell is summed up in the remarkable sentence:

> "The nutrition consists in this, that the raw materials which enter the cell are attracted, now by one, now by another of the constituents of the cell, and adopt its specific movements, and are thus transformed with the same substance (assimilated)."

These drawbacks to an otherwise valuable work make one regret that Prof. Weiss has confined himself to translating Dr. Sorauer's text. Had he rather edited than translated it, no doubt we should have found the English edition free from these defects.

MINES AND MINERALS.

Traité des Gîtes Minéraux et Métallifères. Cours de Géologie appliquée de l'École Supérieure des Mines. By E. Fuchs and L. de Launay. (Paris: Baudry, 1893.)

Étude industrielle des Gîtes Métallifères. By George Moreau. (Paris: Baudry, 1894.)

IN these days, when memoirs and papers follow in rapid succession, the geologist and the miner are justly grateful to any careful compiler who will aid them to keep pace with the ever-widening flood of technical literature. The debt of gratitude is increased when the task is undertaken by a writer like Prof. de Launay, who brings together into one colossal work the results of the labours of his master, the late Prof. Fuchs, and of his own personal researches.

The book is a treatise upon applied geology, which Fuchs defined as the application of geological knowledge to seeking and working mineral deposits. Very rightly Fuchs took a wider basis for his course of lectures at the Paris School of Mines than mere ore deposits. He recognised the fact that the mining engineer of to-day must be a man of wide attainments, capable of giving an opinion upon all sorts of mineral workings, reporting upon gold mines in one journey, upon gem-diggings in the next, and a little later being asked to determine the value of deposits of phosphate of lime or other earthy minerals. For work of this description Prof. Fuchs' lectures formed an admirable kind of training, which has too often been neglected in the past; in fact, until this treatise appeared, many geologists may have failed to realise the vast importance of the subject.

While admitting that various systems of classification may be adopted, Prof. de Launay says that he felt bound to arrange his minerals according to the metalloid or the metal, and he chooses the so-called chemical order. In a huge book of this description, alphabetical order would have been more convenient, and would have prevented some of the anomalies which cannot help striking the reader. The chloride, carbonate, and sulphate of sodium appear under the head of that metal, whilst the borate and nitrate are classed respectively under boron and nitrogen; again, chalk and gypsum are brought under calcium, whilst apatite is placed under phosphorus, no doubt for the reason that the non-metallic element is the

© 1895 Nature Publishing Group